

ASSET MANAGEMENT: AN ESSENTIAL INGREDIENT FOR ROAD NETWORK MANAGEMENT BY ROADS AUTHORITIES – THE NAMIBIAN EXPERIENCE

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ABSTRACT

A Road Management System can be defined as:

AN ALL ENCOMPASSING FRAMEWORK, INCLUDING BOTH INFORMATION PROCESSING AND HUMAN RESOURCES, FOR THE INTEGRATED MANAGEMENT OF THE ROAD NETWORK, INCLUDING THE DETERMINATION AND OPTIMISATION OF ECONOMICALLY WARRANTED PROJECTS, PROGRAMMES, STRATEGIES AND BUDGETS, FOR BOTH DEVELOPMENT AND MAINTENANCE.

A Road Management System (RMS) is becoming more and more critical for the management of the road network. RMS will assist to provide the economically viable projects and to get a list of priorities. Africa and especially Namibia is challenged by the loss of experienced field personnel, deterioration of the road network, and without a scientific and an objective system to assist the managers to manage the road network, the management of the road network is becoming a nightmare.

Namibia went through a major road sector reform from 1995 - 2000 funded by (Swedish International Development Agency) Sida. This restructuring process of the Ministry of Works, Transport and Communications (MWTC) especially the Department of Transport (DOT), brought about three new entities, the Roads Authority (RA), the Road Fund Administration (RFA) and the Roads Contractor Company (RCC).

The RA is to manage the road network, the RFA is to fund the Roads Authority and local authorities from dedicated fund from the Road User Charges (RUC), and the RCC is to do the physical work of the road maintenance and construction. The RMS was included in the Act of the RA therefore it plays a very important role. This helped the RA to look at the RMS seriously.

This paper will look at how exactly the RMS of Namibia was developed and will show the importance of the RMS in decision making, touching on institutional problems, to make the management of the road network efficient and effective. It will look at the necessary ingredients to make a RMS sustainable for developing countries, taking the RMS of Namibia as a model.

1. INTRODUCTION TO THE NAMIBIAN ROAD MANAGEMENT SYSTEM (RMS)

The aim of this paper is to show how the role of RMS is crucial in the transportation sector, by giving a practical example of the Namibian RMS. Transportation Authorities are always challenged by increasing demands for better services under constrained budgets. Better

management systems are urgently needed to support more effective decision making. An Integrated Road Management System is such a system for properly coordinating, evaluating and maintaining infrastructure systems. The development of Road Management Systems (RMS) have started in the early 1960's as a concept, but since it has been implemented in many Countries and Authority's, it has become a process which are a modern day necessity in organizations. At the "Fourth International Conference on Managing Pavements" it was clear that the integration of all systems under a Infrastructure Management System / Asset Management System was important for proper control.

A Road Management System (RMS) is an all encompassing framework, including both information processing and human resources, for the integrated management of the road network, including the determination and optimization of economically warranted projects, programmes, strategies and budgets, for both development and maintenance.

As an essential component of any company or organization dealing with roads, an RMS is inevitable, for proper and optimised planning. Its purpose is to identify needs, quantify needs and Prioritise needs and assist in planning and management. This goal can only be achieved if the decision makers in the organization are convinced, hence the RMS Engineer, or Managers have a big role to play in having a sustainable system running with the correct output.

1.1 Namibian Experience

Many systems were stand alone and running by themselves without being integrated and on top of that there was a high loss of expertise in the old Department of Transport in the Ministry of Works Transport and Communication. This lead to the drawing up of a Master Plan where the objectives were;

- Evaluate the existing systems and situation
- Provide recommendations and guideline regarding; System approach to flow of activities, Computer requirements for Integration, Requirements for Integration, System dependencies and Development Plan

The RMS, because it is based on a computer system, it cannot replace engineering judgement, the tools need to be used together with engineering judgement to get to the correct reasonable results. Hence, the development of the RMS should be inclusive of engineering judgement, proper calibration so that the output is acceptable and reasonable, without that garbage in is garbage out. In many Road Authorities or Department of Transports when asked how many km of roads do you have in your establishment - many different answers are given – Planning Division is different from Maintenance, and even within Maintenance different answers are given, this is a reality. Without a system such as the RMS this question will be answered will with a click of a button, and that has become a reality with the RMS of Namibia.

The Namibian system first implemented what is called the Road Referencing System (RRS) where every road had a start and end point which was defined explicitly. The RRS had a core database where everything is stored and accessed from. To build a house a design is essential and a solid foundation, likewise for the Namibian RMS the Master Plan lead to Architectural System Design (ASD) before any of the Systems were developed.

SYSTEM DEVELOPMENT LIFE CYCLE

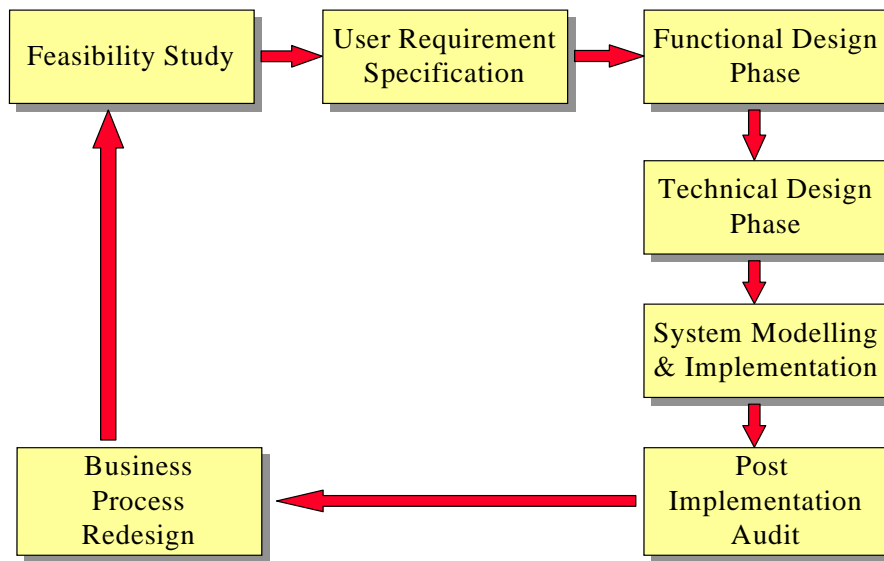


Figure 1: System development life cycle

The Architectural System Design provides the logical and physical application and data architecture as well as the user requirement specification for the various sub-systems. In addition, the various sub-systems cannot be developed in isolation. They are all interdependent. The ASD stipulated the system development life cycle discussed in the following section.

The User Requirement Specification (URS) forms the basis for all future activities in the system development life cycle. It entails a detail layout of the outputs required and the components of the system to achieve this. A high level entity model is required. The aim of this activity is to provide decision makers with a holistic view of the entire system and to give an IT company sufficient scope to enable them to quote for the actual development and implementation of the system.

The Functional Design Phase deals with the system operational requirement, infrastructure requirement, application maintenance, data flow through the applications and detail regarding processes and data validation. (Description of engineering models, inputs and outputs form part of this phase).

The Technical Design Phase looks at the required hardware, networking requirements and database management. Detail table designs for identified entities within the system are finalised with the proposed capacity planning for data capturing and maintenance. (This phase defines the structure of the database).

System Modelling entails the physical layout and coding of applications and reports. The implementation includes user testing of data capturing, validation, processing and reporting as well as the integration with other existing sub-systems. (Users, after training, start using the system with documentation at hand).

The Post Implementation Audit is the comparison of the delivered system against the URS.

The methodology was followed for each and every sub-system developed. The foundation of the RMS is sound and because of that foundation the systems are working by giving long awaited results. In addition all the systems developed have been integrated through having one data base, and the same look and feel throughout the whole sub-system. In Africa many systems are in existent but they are not giving the required results because they do not have Master Plans nor ASDs. This results in wasting invaluable resources leading to subsequent failure of the systems.

2. BACKGROUND ON THE NAMIBIAN ROAD REFORM OF THE MWTC 2000 PROJECT

When government came into power with Namibia's Independence on 21 March 1990, some of its main policy objectives were to:

- revive and sustain economic growth,
- promote an efficient use of scarce resources, which would create employment opportunities, and
- help to alleviate poverty.

Government found that the availability of safe, effective and efficient transport services would be instrumental in achieving these policy objectives.

On 4 October 1994 Government adopted the "White Paper on Transport Policy" which called for the improvement in the performance of the transport sector and for encouraging increased competition as the main instrument to achieve increased efficiency.

It also called for the introduction of a system of road user charging for full recovery from road users of the costs of providing and maintaining road infrastructure according to the principle of minimising transport costs, with co-financing from general revenue sources for that part which does not directly benefit road users.

This is inextricably linked to sustainable availability of funding at the required optimal level, as well as the institutional capacity to utilise such funds efficiently for the benefit of road users.

To give effect to Government's policies and objectives, the Ministry of Works, Transport and Communication launched the MWTC2000 Project during 1995 to reform the road transportation sector as well as the Ministry.

The institutional arrangements for planning, designing, constructing and maintaining Namibia's national roads network has been restructured and the arrangements for the funding via the national budget will be replaced by funding via a Road Fund and a Road User Charging System.

The institutional reform has resulted in the establishment of the Roads Contractor Company, Roads Authority and the Road Fund Administration. The entities were launched on 12 July 2000 in Windhoek. In short all the three entities will function by a governing board of directors. The Roads Authority (RA) under the auspices of the Minister of WTC, manages Namibia's rural roads network. The Road Fund Administration, under the auspices of the Minister of Finance, manages the Road User Charging System to secure

and allocate funding to achieve a safe and economically efficient road sector. The Act is solid but its applications as intended in the Act needs time. This paper does not look into this area.

3. INTRODUCTION TO THE MASTER PLAN OF THE RMS

Namibia had a lot of stand alone systems which did not interface with other systems, like many of the past Pavement Management Systems throughout the world. On top of that there has been duplication of efforts and data which was very costly. Vendors would demonstrate their proprietary systems, DOT would buy them, and then there would be no support, the suppliers would vanish or would only be interested in selling their commodity without the support. Many of them looked impressive and promised to do anything, but when bought and implemented, they could not deliver the services and products as required. This initiated a need for a proper Master Plan.

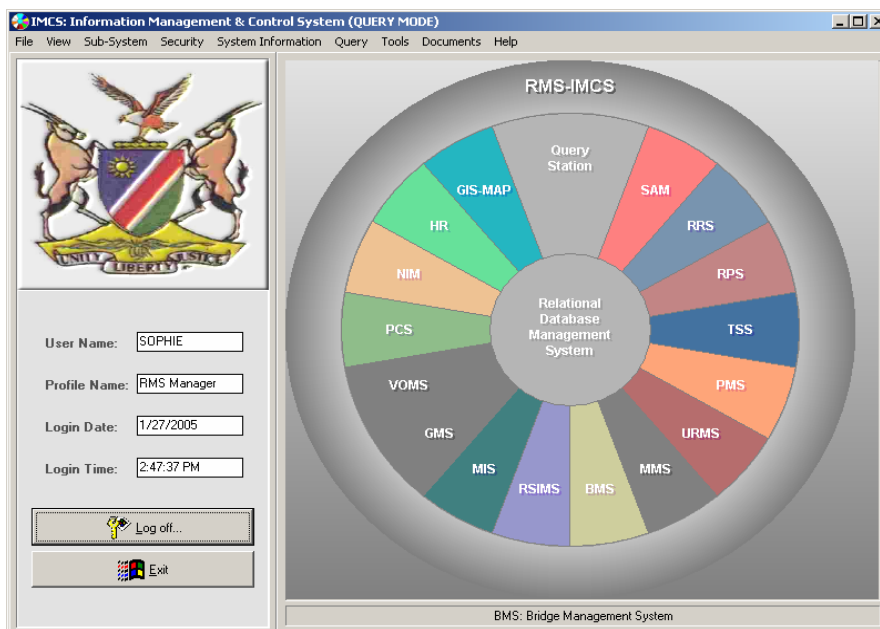


Figure 2: RMS Wheel

3.1 Introduction and output of the Master Plan

Based on technologies of road management in the world and experience in southern Africa, the Road Management System Master Plan identifies the required Sub-systems and priority thereof for a sustainable RMS in Namibia.

The sub-systems which will be incorporated in the RMS are as follows:

- Road Referencing System (RRS) or network definition
- Information Management and Control System (IMCS)
- Traffic Surveillance System (TSS)
- Pavement Management System (PMS)
- Unsealed Road Management System (URMS)
- Bridge Management System (BMS)
- Project Control System (PCS)

- Maintenance Management System (MMS)
- Geographical Information System (GIS)

The basic principle to develop and operate a sustainable network level RMS for Namibia, is to keep each sub-system simple but to ensure that comparable parameters are produced by the various sub-systems. Simple, but sound procedures are used to identify candidate projects on the network level. Thereafter, candidate projects identified for scheduled maintenance, major rehabilitation or upgrading and the provision of new facilities, will be further investigated and analysed to ensure economic justification.

The fastest way to provide integrated network results and to test the IMCS, is to develop one of the major sub-systems, identifying needs, at the same time. Combining the development of the RRS, IMCS, TSS, PMS and the GIS into one phase of development will complete the data flow and operation of one major sub-system. With this in mind, and taking into account the dependencies of sub-systems, the development of the RMS is scheduled into three phases namely: Phase 1; RRS, IMCS, TSS, PMS and GIS; Phase 2 URMS, BMS, and MMS; Phase 3 PCS. Each phase was estimated to take maximum 18 months.

Actual cost for the development per sub-system ranges from N\$ 600 000 to N\$ 1 000 000 – (1N\$=1South African Rand=0.1US\$) at this stage depending on the complexity of the sub-system. The Master Plan forecast N\$ 1,5 million per sub-system. This amount is just to place the shell, and does not include the cost of collecting the data nor the maintenance of the system. In actual fact the cost of the sub-systems depending on the complexity has run from N\$ 500 000 to N\$ 1 000 000.

3.2 Summarized RECOMMENDED SYSTEMS FOR NAMIBIA RMS

The main requirements for an RMS in Namibia can be summarised as follows:

- To determine a stable funding requirement for the provision and maintenance of the road network infrastructure. This information will be used by the Road Fund Administration to determine appropriate road user charges.
- To assist the RA in being effective (doing the right things) and efficient (doing things right) in the provision of a safe and cost-effective road network.
- The primary tool to ensure accountability towards the Namibian public.

Based on experience with Road Management Systems in Namibia and Southern Africa, developments in computer technology, the staff shortages in the RA and requirements specified for the RMS in the TOR, the following further requirements and essential features are listed:

- The RMS must be sustainable, affordable and appropriate to the decision making needs and scarce financial and manpower resources
- Be able to conform and integrate with the day-to-day activities of the RA
- Flexible for stage development and implementation in a changing environment
- In line with the RA (DOT) Information Technology Policy
- Make use of a central database for all sub-systems
- Facilities to monitor the present network condition over time
- Facilities for developing probabilistic models for predicting maintenance and rehabilitation costs
- Facilities for preparing medium- to long-term plans and well motivated estimates of funding needs

- A mapping facility for the graphical representation of the road network and related information
- A uniform user-interface for all systems

4. SOME EXAMPLES OF OUTPUT AND USE OF RMS

These examples provide some background to the current condition of the surfaced roads in Namibia and also show the estimate stable funding level for the maintenance and Rehabilitation of the surfaced road network. Namibia has in total of 5464km of paved roads as shown.

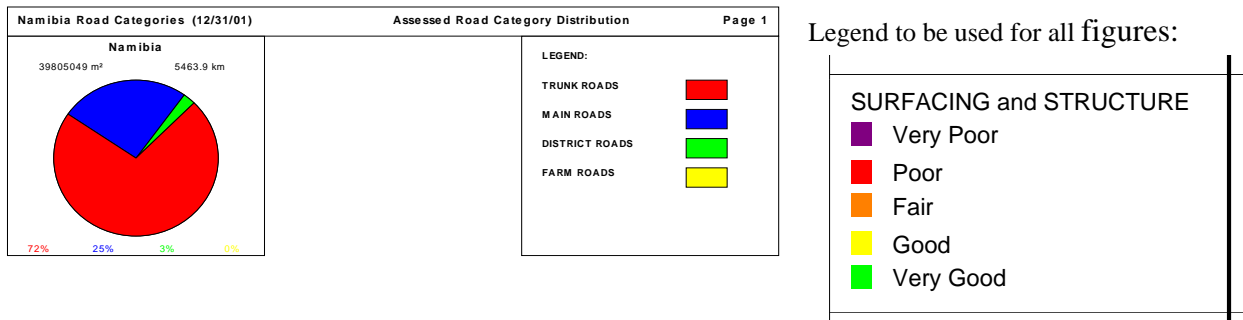


Figure 3 RA Road Network

4.1 Replacement Value

Roads are assets and they should be regarded as such. A conservative calculation indicates a value of approximately N\$ 7,7 billion to replace only the top layers (base and sub-base) and bituminous surfacing (black top bitumen layer) of the paved roads. This does not include the asset of the land, value of earth works, bridge structures, road furniture or unsealed roads.

4.2 Age Of The Road Network

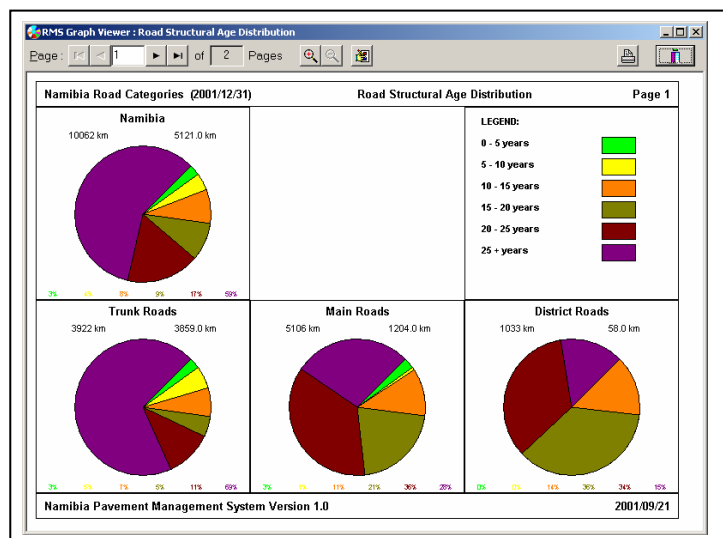


Figure 4: Pavement Structure Age Distribution

4.2.1 Namibian Situation:

76 % of the total paved road network is more than 20 years old.

Due to our dry conditions, good road building materials and relative light traffic loads, the expected life can be extended with timeous routine maintenance (crack sealing, patching etc.) and periodic maintenance (reseal). However 206 km can be described as “Poor” and “Very Poor”, requiring immediate structural rehabilitation and a further 497km is considered to be in a warning state, requiring attention within the next 5 years.

The purpose of a bituminous surfacing is to prevent moisture ingress into the pavement, to provide skid resistance and to protect the pavement structure from traffic wear. The average effective life of this surfacing layer in southern Africa is 10 - 15 years – mainly due to oxidation and hardening caused by ultra violet rays, making this layer water permeable.

4.3 Funding Requirement

Pavement Management System identified needs (2001)

FUNDING REQUIRED FOR	1 st Year need	Ave/annum (5 year)
REHABILITATION	N\$ 252 million	N\$ 121 million
RESEAL	N\$ 175 million	N\$ 108 million
ROUTINE MAINTENANCE	N\$ 57 million	N\$ 57 million
TOTAL NEED (Surfaced Roads)	N\$ 484 million	N\$ 286 million

4.4 Long term requirement

The performance of every surfaced road segment has been analyzed and the implications of different funding scenarios evaluated over a period of ten years.

The following graphical displays show the impact on the network condition and remaining life for different funding allocations.

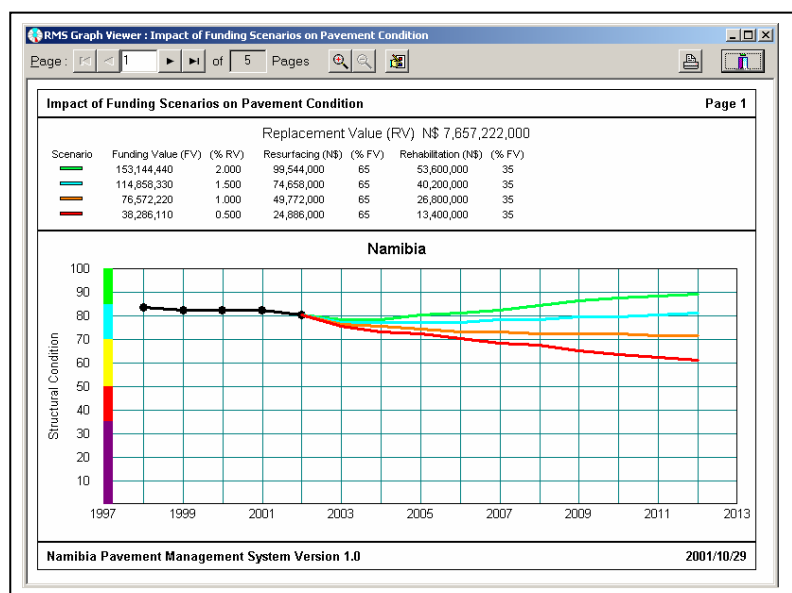


Figure 5: Impact on the Pavement Structural Condition

A minimum of N\$ 115 million/annum is required for reseal and rehabilitation to maintain the current condition. Adding an average routine maintenance requirement of N\$ 57 million/annum, the minimum annual requirement for surfaced roads is calculated at N172 million.

However, from Figure 6 it is evident that a higher funding level is required to increase the average remaining life to more than 10 years. A funding level of N\$153 million/annum will ensure an average remaining life of 11 years.

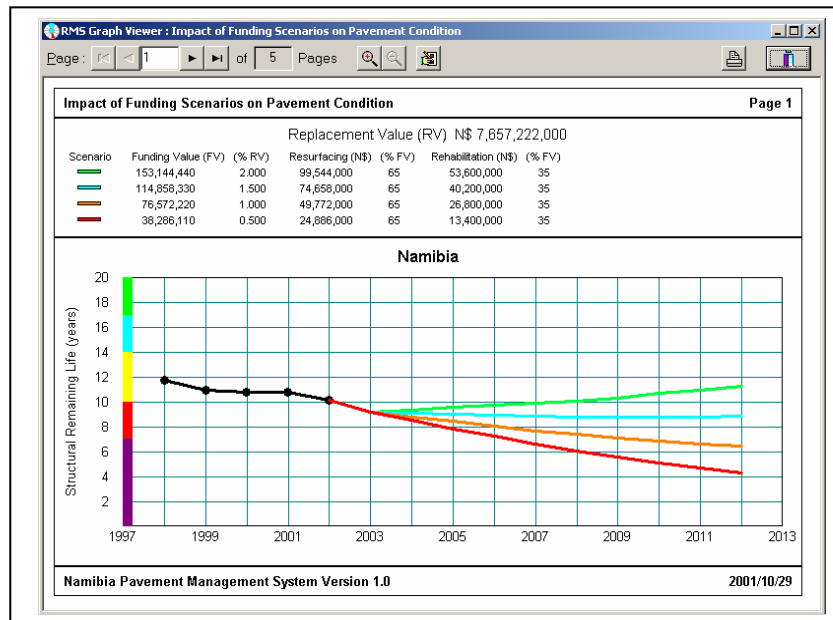


Figure 6: Impact on the Average Remaining Structural Life

Figure 7 indicates that an amount of N\$ 153 million/annum spent on reseal and rehabilitation, would eliminate the backlog within ten years. Adding an average routine maintenance requirement of N\$ 57 million/annum, a total amount of N\$ 210 million is required per annum for maintenance of surfaced road pavements.

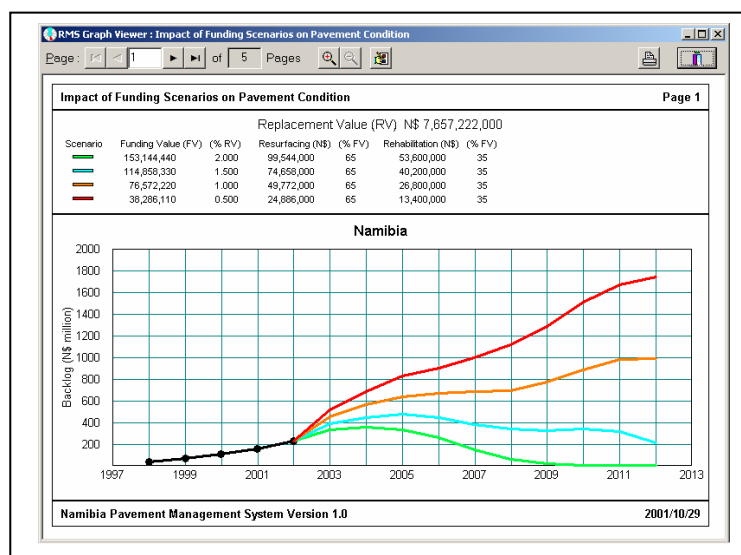


Figure 7: Impact on the Backlog (Accumulative shortfall)

5. LESSONS GAINED FROM THE NAMIBIAN RMS

It needs to be understood that the systems developed by developed countries may or many not work in an African environment, care needs to be taken in selecting suitable systems. Taking off the shelf systems and implementing it in Africa without following the methodology/life cycle has proven to be a failure in most of the countries. Firstly, the African pavements are different from European/American countries and hence need special attention and different consideration. Secondly, some of the sophisticated systems developed might be too complicated and African countries cannot sustain these systems because of the lack of resources such as funds and qualified personnel.

Even if the funds for developing these systems are coming from donors it needs to be used to the benefit of the organization and the country by providing information for good decision making that will save Road Authorities in millions. That is why Master Plans and ASDs are necessary. It is not what the donor wants that has to be implemented in African Road Authorities or organisations but what the organization itself wants, which is sometimes difficult to define because of lack of vision and expertise. The methodology applied in Namibia in implementing systems have been successful and hence the reason for this paper to share it with other organisations and not to repeat the same mistakes that others have done.

Number of times consultants have been appointed for various studies where documents and reports have been produced one after the other, but because they are not accessible these reports are shelved and are full of dust, the knowledge remains with few people only, and hence when they die or retire everything else around them collapses. With a proper implementation of RMS these documents will be accessible easily for future generations making the management of organisations sustainable, effective and efficient.

In any successful RMS a champion and a driving force is required to take the flag and run with it - without that the RMS will not be successful. The support of the top management and Boards is essential in making any RMS successful. In Namibia, the support has not been much, but there are dedicated champions that make the system successful through team work. Support of the Board and top executives is a pre-requisite for any successful RMS.

It needs to be noted that RMS is a specialised area of Civil Engineering, and training and appreciation of the skilled staff is essential. It is not only computer systems giving output, the essential aspect is what goes to the systems to make it give the correct results by modelling the experiences and skills of experts into the required environment to produce results by almost simulation, predictions and at the end bringing engineering judgement to the output. Systems should not be complicated; they should be simple, straightforward giving results. The results do not have to be 100% perfect initially, with time they will be perfected.

The contradictory needs and approaches of Network Analysis and Project Analysis has been also the core cause of many failures of RMS's in many organisations. RMS is a strategic, network based system, in some cases programme or tactical based system. Project Engineers have been bogged down with details trying to make the RMS systems project oriented instead of network oriented, and once they start developing the systems they never finish it because the number of details required has no ending. This is experience in the Namibian RMS, where the GIS system was to be made a geometric system and each and every curve was supposed to be placed in the system making the system never ending. Once the basic correct information is in, it needs to be remembered

that results are needed on the table and need not be perfect but needs to be workable and reliable.

Another crucial issue is Africa is exporting all the educated experts to developed countries such as Australia, Europe and the USA. Putting such a system in place where all the information is accessible for everyone will ensure the proper management of the road network, through transparency, efficiency and effectiveness. Some processes and rule sets will be followed that are defined explicitly which will assist the new personnel to somehow know what is happening in the Road Network. Countries such as Namibia are also affected by loss of expertise.

Another consideration that needs to be given attention to when developing systems is that systems should not be black boxes, changes should be flexible. Systems should work for the people and not the people for the system - unfortunately this is not the case in many authorities, it is hoped that this paper will change that attitude.

6. FUTURE DEVELOPMENTS

The optimum budget nor the condition of the road network should not be "thumb sucking" but should be based on sound engineering judgement. The paved roads can already give the results as discussed in the above sections. The data for the entire unsealed road network was available at the end of December 2002 and the system is functional but the full output is not yet has not yet delivered fully.

Network Integration Module the most important tool of the RMS sub-system was launched and has succeeded in its objective. The network integration module will collate the important summarised information from the various sub-systems of the RMS as well as manually entered information obtained from other needs not yet identified through a formal system. The World Bank Mode called Highway Development and Maintenance Model, the HDM-4 was incorporated into the NIM, as the best international tool already developed. The RMS of Namibia and HDM-4 will complement each other – HDM-4 component is funded by a donor. The project was completed March 2003, but could not yet deliver the full final output due to institutional problems. It is envisaged that the Long Term Strategic plan will be completed soon to be used for the planning of the Medium to Long Term budget of the RA, which is about 1 billion N\$ per annum.

7. CONCLUSION

The Namibian RMS is on the right track although some of the institutional problems are still present which challenges the RMS success. The role of the RMS in new roads authorities is something that one cannot turn a blind eye to, as Africa is losing expertise, and systems like these are vital for sound decision making which was the reason or the whole purpose of commercialization process for the sake of making the RA more effective and efficient to serve the road users based on business principles.

The vision of the Namibian RMS is to have a working RMS to assist decision makers to make sound and better decisions based on facts, and in addition, to make the Namibian RMS an internet based system. Although the availability of bandwidth is a major problem in Southern Africa, the possibility of adding Arial photography will be regarded as the ultimate cherry on the already successful RMS cake. It is believed that the purpose of this paper is achieved, in showing how a properly managed RMS, can start giving rational management information for assistance in decision making from a strategic level, to the tactical level and even providing certain information on aspects at the project level. These

results ultimately assist in sound decisions which can be justified to the road user and serves the mission of Roads Authority.

8. REFERENCES

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